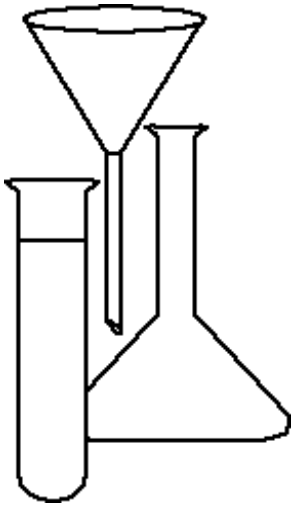
Activity 7

Identifying Risks at a Superfund Site



Duration	2 class periods
Grade Level	7-12
Key Terms/ Concepts	Exposure Hazard Ranking System Hazardous substance Hazardous waste National Priorities List Preliminary assessment Risk Site inspection Superfund
Suggested Subjects	Chemistry Earth Science Geology Physical Science

Purpose

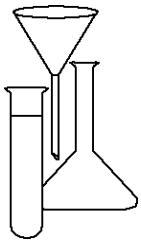
This activity helps students understand the types of risks found at Superfund sites and how these risks are identified and assessed. They learn how sites are discovered and where to report potential hazardous waste sites. They discuss the activities undertaken by the government or other parties at hazardous waste sites to identify sources of contamination, determine the type and extent of contamination, and evaluate the risks posed to human health and the environment.

Background

The **Superfund** Program in the United States was created as a response to widely publicized contamination problems caused by hazardous waste. The Superfund law specifies a process for reporting potentially contaminated hazardous waste sites to the Federal government. The U.S. Environmental Protection Agency (EPA) and states investigate hazardous waste sites to determine the seriousness of the contamination. The most serious sites are cleaned up using Superfund authority. Some will be cleaned up by State governments, and some will require no cleanup because they pose no danger to people or the environment.

The extent of the hazards of **exposure** posed by each site discovered are assessed. Tied to the concept of exposure is the concept of **risk**. Risk is a measure of the probability of suffering harm or loss. For example, risk is used to measure the probability that a person will be exposed to a **hazardous substance** (like mercury) and the chances that the exposure will harm the person's health. Environmental risk is a measure of the probability that hazardous substances will harm the environment.

There are two types of risks associated with hazardous substance contamination. The *risk of exposure* is a measurement of the probability that being near a hazardous substance will lead to exposure of a person or the environment. The *risk of injury* after



exposure depends on the toxic or other harmful effect associated with the particular contaminant.

For more information on risk identification, see the Suggested Reading list found at the end of the Haz-Ed materials. Other Haz-Ed materials that are related to this topic include *Warm-Up 4: Risk Concepts* and *Fact Flash 9: Common Contaminants.*

Preparation

1. Gather the following materials:

   - Copies for each student of:
     Fact Flash 1: Hazardous Substances and Hazardous Waste
     Fact Flash 2: The Superfund Cleanup Program
     Fact Flash 3: Flowing Railroad Hazardous Waste Site

   - Copies for each group of:
     Student Handout, *The Preliminary Assessment and Site Inspection for the Flowing Railroad Site*

2. Read the Fact Flashes to prepare your lecture. Also refer to Warm-Up 4 for information on risk and probability in relation to Superfund sites.

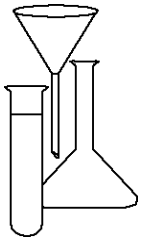
3. Distribute Fact Flashes 1, 2, and 3, and have students read them for homework.

4. OPTION: As extra-credit homework, give several students library assignments to look up one of the important concepts or contaminants included in Fact Flash 3. For example:

   - Superfund
   - Asbestos
   - TCE
   - PCB
   - Point Source
   - Nonpoint Source.

   Some information can be found in *Fact Flash 9: Common Contaminants*. Instruct each student to be prepared to make a short report on his or her research at the beginning of the next class on identifying risks.

   If you do not assign these reports as extra credit homework, you may want to gather some information yourself to present to your students at the first class.



Procedure

Class #1

1. Have each student assigned extra-credit homework make his or her report to the class, or present information on these topics yourself.

2. Allow students to ask questions and discuss the information to help prepare them for Class #2.

Class #2

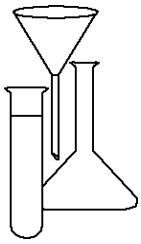
1. Briefly review the main points from Fact Flashes 1, 2 and 3. An Instructor Fact Sheet, *Information Highlights on the Flowing Railroad Site*, is included at the end of this lesson for your use.

2. Ask students how contaminants might spread from the hypothetical site. Possible answers include:

    - The wind can blow contaminant vapors
    - The wind can blow small soil particles to which contaminants are attached
    - Contaminants can be washed into the Flowing River by rainfall running off the site
    - Liquid contaminants can flow down through the soil to the groundwater
    - Contaminants can be washed down through the soil to the groundwater by rainfall
    - Groundwater moving underground can spread contaminants in the aquifer
    - Contaminated groundwater can move into the Flowing River
    - Surface water sediments can be washed downstream, particularly during floods.

3. Ask students how animals or plants might be exposed to contaminants from the site. Possible answers include:

    - The wind can blow contaminants to tree leaves, grasses, or crops
    - Animals can eat contaminated plants
    - Fish and aquatic plants can be exposed to contaminants washed into the Flowing River
    - Farmland crops could be exposed to contaminants through irrigation from the Flowing River.



4. Ask students how people in Ruralville and Utopia might be exposed to contaminants from the site. Possible answers include:

   - Eating contaminated crops
   - Eating contaminated fish from the Flowing River
   - Utopia residents drinking contaminated water from their municipal wells
   - Ruralville residents drinking contaminated water from the Flowing River
   - Children playing on the site
   - Fishermen crossing the site to get to the Flowing River
   - Ruralville residents breathing contaminated air blown off the site
   - Ruralville and Utopia residents taking showers with contaminated water.

5. Ask students to name some factors that are important to consider in determining the risk of exposure to site contamination. Possible answers include:

   - Amount (volume) of contamination originally released at the site
   - Concentration of the released contaminants
   - Degree of dispersion (dilution) of the contaminants (more dispersion equals less risk)
   - Frequency of contact with contaminated water, soil, plants, and animals
   - Amount of physical, chemical, and biological transformation of the contaminants into a harmless state (degradation, containment).

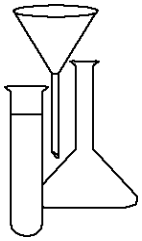
6. Distribute the following Student Handout, *The Preliminary Assessment and Site Inspection for the Flowing Railroad Site*. Divide the class into groups of 5 or 6 and instruct each team to choose a spokesperson.

7. Have each group discuss and answer the questions listed on the handout. After about 10 minutes, have the class reassemble and have the spokesperson for each team present the team's responses.

8. Record the responses and discuss any differences between the groups. Why does EPA focus on these questions when investigating potential hazardous waste contamination? Does the class believe direct contact is more serious than food chain contamination? Is human health protection more critical than protection of sensitive environments?

Extension (Optional)

- Consider inviting an EPA or State Remedial Project Manager (RPM) involved in overseeing hazardous waste cleanup projects at a site in your state to discuss how risks at that site were identified and assessed. Also ask the speaker to discuss the steps taken to put the site on the NPL or other priority list.



Instructor Fact Sheet — Information Highlights on the Flowing Railroad Site

FRR Enterprises is the parent company that owns Flow Automations (currently operating) and the Flowing Railroad (no longer operating).

The Flowing Railroad site is an inactive train yard where locomotives were repaired and maintained.

The Flowing River borders the site to the east. It supplies fish that nearby families eat 3 to 4 times a week and feeds the aquifer that supplies drinking water and irrigation to homes, businesses, and farms (municipal wells and the irrigation intake are 3 miles downstream from the site).

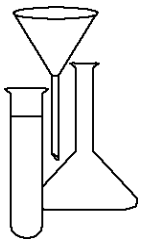
8,000 people live within 1 mile of the site and 1,400 people live within 1/4 mile.

Contaminants identified by EPA sampling include:
- Lead, zinc, and copper wastes, which result from building locomotive cars;
- PCBs, which can be released if electric power transformers are punctured; and
- TCE, a volatile organic compound, probably used to degrease and clean locomotive parts.

The potential for contamination of the Flowing River and other surface water and groundwater (e.g., the aquifer) could be increased by rain and melting snow washing through contaminated areas.

Samples from a shallow well drilled at the site contained lead and a high concentration of TCE, but the actual extent of the contamination is unknown. The soils in a few areas of the site have been contaminated; full tests of the soil have not been conducted.

Community concerns include:
- Potential release of asbestos, which could contaminate the air
- Peculiar, noxious odor from drinking water faucets in Ruralville
- Possible health impacts for people who regularly eat potentially contaminated fish
- Potential impacts on the health of people who breathe in TCE fumes
- Reported increase in the number of cancer cases in the surrounding areas
- Potential environmental and economic impacts on soil and crops contaminated by irrigation water
- Future use of the site property
- Potential economic impacts on Ruralville if FRR Enterprises had to lay off workers or close Flow Automations if the company cannot afford the cleanup costs.



The Preliminary Assessment and Site Inspection for the Flowing Railroad Site

Discuss within your group the following questions about the Flowing Railroad site. The only information you have about the site is contained in the fact sheet you just read. Your group should answer these questions (space is provided after each question) and select a spokesperson to present your answers.

1. What are your biggest concerns regarding the site and why?

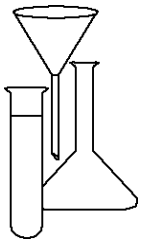
   - *Health concerns (e.g., cancer, neurological disorders) from drinking polluted water, food chain contamination, or breathing air contaminated by the site?*

   - *Environmental resource concerns, including fish in the Flowing River?*

2. What are the ways in which the contamination can spread? (These are commonly referred to as “routes of migration.”)

   - *Melting snow?*
   - *Rain?*
   - *Humans trespassing on the site?*
   - *Fish?*
   - *Wind?*

   Are there other ways?



3. How would you rank the threats to human health and the environment from this site? Choose from the list of threats below, or come up with your own. What is the rationale for your ranking of the threats?

   - *Groundwater, the source of drinking water for the neighboring Town of Ruralville and the nearby City of Utopia?*
   - *Flowing River, which serves as a source for irrigation and municipal wells, in addition to recreational and subsistence fishing?*
   - *Soil?*
   - *Air and wind?*

4. What actions could be taken now?

   - *Put up a fence?*
   - *Provide drinking water?*

   Are there others?